Stabilization of Proximal Interphalangeal Arthrodesis of Lesser Toes Using K-wires vs. Implants: A Comparative Biomechanical Cadaveric Study

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Introduction/Purpose: Lesser toe proximal interphalangeal (PIP) joint arthrodesis is one of the most common foot and ankle elective operative procedures. Currently, the most common method for fixation of the PIP joints is utilization of intramedullary Kirschner wires (K-wires). Implantation of K-wires have been shown to be associated with a fair number of complications including hardware failure, loosening, bending, mal-union, non-union, wire migration, and infection. These complications have led to the development of intramedullary devices for fixation. Our hypothesis was that the memo-metal X-fuse PIP joint arthrodesis implant (Stryker, Kalamazoo MI) would provide a stronger and stiffer arthrodesis than Kirschner wire fixation.

Methods: Six matched fresh frozen cadaveric second toe pairs were used in the study. Six PIP joints were prepared and fixed with K-wires and the six contralateral PIP joints were prepared and fixed with the X-fuse system. All specimens were then potted and fixed to a custom jig. Specimens were then cyclically loaded with extension bending force of the PIP joint mimicking natural upward bending force in walking using 2 N step increases of force with 10 cycles per step. Failure was defined as 4 mm of actuator displacement. Load to failure was then assessed. Paired t-test was utilized for statistical analysis.

Results: The average force at failure (defined as 4mm of displacement) for the Kirschner wire was 93.3 N (SD 25.8) which was significantly greater than the average for the X-fuse system, 65.0 N (SD 13.8). P-value was 0.0053. Failure of the K-wire resulted from bending of the K-wire itself or breaching of cortical bone. Failure of the X-fuse typically resulted from implant pullout.

Conclusion: Contrary to our hypothesis, K-wires provided a stiffer and stronger construct than the X-fuse system. Successful bony fusion is the clinical outcome of interest, and this cadaver study was used to assess stability of the fusion site at time zero after surgery. Limitations of this study include a relatively small sample size.

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